

Prepared by:



DAN RIVER STEAM STATION
PRIMARY ASH BASIN
SECONDARY ASH BASIN
CLOSURE PLAN

OCTOBER 10, 2016

Certified by:



Amec Foster Wheeler Environment & Infrastructure, Inc.

2801 Yorkmont Road Suite # 100

Charlotte, NC 28208

License Number: F-1253

DR_CLOSE_PLN

Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Dan River Steam Station (Dan River) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Primary Ash Basin and Secondary Ash Basin (Ash Basins) located in Rockingham County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR units requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps required to close the Ash Basins at Dan River consistent with recognized and generally accepted good engineering practices. Closure of the Ash Basins will be designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The Ash Basins will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. § 257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basins include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to off-site and/or on-site permitted landfills. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankments will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed placed in a beneficial use facility identified at the time of closure. Decontamination

procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time, and the estimates are based on bathymetric surveys and historical topography as of July 2014. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Primary Ash Basin	1,012,000
Secondary Ash Basin	324,000
Estimated Total	1,336,000

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basins pursuant to 40 C.F.R. § 257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the Ash Basins was initiated in 2015 pursuant to 40 C.F.R. § 257.102(e) and will be completed by August 2019 pursuant to 40 C.F.R. § 257.102(f)(1)(ii).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basins are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basins will be completed by 2019.

Table 2. Estimated Time Frames for Closure Activities

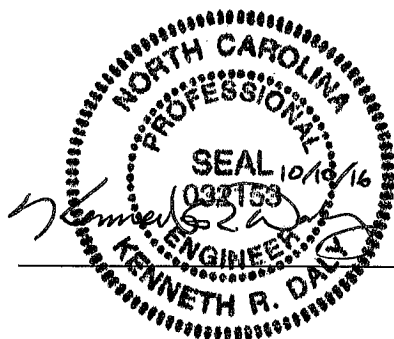
Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NPDES, E&SC, Air)	1
Dewatering and Stabilization	2
NCDEQ Dam Decommissioning Approval	0.5
CCR Grading and Excavation	1.5
NCDEQ Landfill Approval	1.5

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Kenneth R. Daly, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information and belief, that the information contained in this written Closure Plan dated October 10, 2016 was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE _____



DATE _____

Prepared by:



MARSHALL STEAM STATION
ACTIVE ASH BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:



1600 Perimeter Park Drive, Ste 400

Morrisville, NC 27560

Engineering Firm License Number: C-2243

MAR_CLOSE_PLN
Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment at the Marshall Steam Station (Marshall) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015) (CCR Rule). URS Corporation – North Carolina (AECOM) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102(b) of the CCR Rule. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Active Ash Basin (Ash Basin) located in Catawba County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. The narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR unit (as needed);
3. A description of the final cover system designed pursuant to 40 C.F.R. § 257.102(d), a description of the methods and procedures to be used to install the final cover, and a discussion of how the final cover system will achieve the performance standards specified in 40 C.F.R. § 257.102(d);
4. An estimate of the in-place CCR inventory requiring closure;
5. An estimate of the largest area of the CCR unit requiring a final cover;
6. A closure schedule; and
7. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102(b).

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basin consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into in-place CCR, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Ash Basin “intermediate-risk,” which would require them to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke Energy’s completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Ash Basin as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Ash Basin by leaving the CCR in-place, Duke Energy

contemplates that the Ash Basin will be closed in accordance with the requirements of 40 C.F.R. § 257.102(d).

The method to close the CCR unit in-place will include: removal and treatment of the bulk water/free liquids; interstitial/pore water dewatering (as needed) and treatment; stabilization of remaining CCR sufficient to support the final cover system; grading of in-place CCR to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; and post-closure groundwater monitoring and cover maintenance. The final cover system will be designed to minimize infiltration; erosion; and meet, or exceed, the requirements of the final cover system specified in 40 C.F.R. § 257.102(d)(3)(i). Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer. A small portion of the Ash Basin will be subject to closure-by-removal.

2 CCR REMOVAL AND DECONTAMINATION

There are areas, primarily the area of the Ash Basin where the Industrial Landfill Phases 2-4 are proposed to be constructed, that closure-by-removal is selected in order allow for development of future plant infrastructure or transmission. In-place CCR in those areas will typically be dewatered (if needed), excavated, and then consolidated (placed) into the major portion of the basin which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts and miscellaneous piping, will be decontaminated and abandoned in-place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure.

Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Ash Basin will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Ash Basin will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;

- An 18-inch thick protective soil cover layer;
- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to minimize erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover, then to sediment basins (as appropriate), prior to discharge until the site is stabilized by vegetation. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and reduce maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Ash Basin will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) is further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Ash Basin, final closure is anticipated to be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes the estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

- (A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Ash Basin will meet or exceed this criteria. The geomembrane by itself results in a lower effective infiltration rate than the 18 inches of 1×10^{-5} centimeters/second soil standard.

- (B) The infiltration of liquids through the CCR unit will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component of the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

- (C) The erosion of the final cover system will be reduced by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternate final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, and prior to the completion of closure, stormwater run-off and wastewaters generated from areas outside the Ash Basin's drainage catchment (which had previously been routed through the basin when it was active) will be permanently diverted for treatment (as needed) and discharged at other locations within the site.

- (D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover system will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;
5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating and abandoning in-place, or removing the appurtenant structures within the CCR unit;
8. Clearing and grubbing;
9. Constructing laydown areas and access roads;
10. Where needed, interstitial/pore water dewatering and treatment;
11. Grading CCR to achieve design cover system subgrade elevations;
12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures; and

14. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Ash Basin during the initial phases of construction. To provide a stable platform for installation of the cover system, interstitial/pore water may be removed and treated during construction. With the diversion of wastewater and stormwater generated from areas outside of the Ash Basin drainage catchment (*which had previously been routed through the basin when it was active*), the volume of interstitial/pore water within the basin is expected to further decline over time. The stormwater outlet will be constructed following the final phase of cover system installation. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore water dewatering, cover system installation, and stormwater outlet construction) will stabilize the CCR sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on bathymetric surveys, historical topography and soil borings as of December 2015. The annual surface impoundment inspections completed, in general accordance with 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, in general accordance with 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Ash Basin	13,920,000

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will undergo closure-in-place in the Ash Basin pursuant to 40 C.F.R. § 257.102(d). The largest area of the CCR unit that will be open (and requiring a final cover) at one time is estimated to be 320 acres.

6 CLOSURE SCHEDULE

Closure of the Ash Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within eleven years of the commencement of closure activities. The closure time frame includes three two-year time extensions beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basin will need to be lengthened due to:

- The Ash Basin being larger than 40 acres (estimated 394 acres);

- The amount of material needed to close the Ash Basin (estimated to be about 2.7 million cubic yards);
- Volume of bulk water/free liquids to dewater (greater than 150 million gallons);
- The surrounding geology (shallow rock resulting in limited soil volume per given area, limited availability of soil meeting the permeability requirements outlined in the CCR Rule, rocks in the soil that could damage the geomembrane would need to be removed, etc.); and
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure subgrade stability is adequate, and other measures may need to be employed to stabilize the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basin within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basin are included below in Table 2. We estimate that all of the closure activities for the Ash Basin will be completed by 2029.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	3
NCDEQ Dam Decommissioning Approval	0.5
CCR Grading and Excavation	2.5
Final Cover Installation	7

*Estimated closure activity time frames may include some overlap.

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

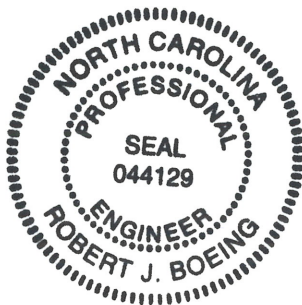
I, Robert J. Boeing being a registered Professional Engineer in the State of North Carolina, do hereby certify to the best of my knowledge, information and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed in general accordance with the requirements of 40 C.F.R. § 257.102(b) and has been prepared in general accordance with recognized and generally accepted good engineering practices.

SIGNATURE



DATE

10/10/16



Prepared for:
DUKE ENERGY

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Marshall Steam Station
8320 Highway 150 East
Terrell, North Carolina 28682

MARSHALL STEAM STATION INDUSTRIAL LANDFILL NO. 1

CLOSURE PLAN

OCTOBER 10, 2016

Prepared by:



9751 SOUTHERN PINE BLVD
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CLOSURE PLAN

1.0 INTRODUCTION

This Closure Plan was prepared for the Marshall Steam Station (MARSS) – Industrial Landfill No. 1. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Carolinas, LLC (Duke Energy) in the closure of active waste units. The MARSS Industrial Landfill No. 1 is owned and operated by Duke Energy. The landfill is located in Catawba County, North Carolina on Duke property, approximately 1.5 miles north of the Marshall Steam Station, in part within the footprint of an inactive ash basin. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The design of constructed cells (Phase 1, Cells 1 & 2) provides approximately 1,752,000 cubic yards of airspace available for waste placement (including operational soils).

2.3 Largest Area Requiring Cover System

The landfill area of constructed cells (Phase 1, Cells 1 & 2) of approximately 19 acres is currently the largest area that will need to be capped.

2.4 Closure Performance Standard

2.4.1 Final Cover System

The cover system has been designed to reduce infiltration into the landfill and to resist erosion. The permeability of the least permeable layer is on the order of 1×10^{-12}

cm/sec. This is equal to or less than the permeability of the bottom liner system and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetated erosion layer;
- an 18-inch thick soil barrier;
- a geocomposite drainage layer; and
- a 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane.

2.4.2 Alternate Final Cover System

No alternate final cover system is proposed.

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than five percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for

the final cover, the internal and interface friction angle of all the components must be greater than the slope angle by a margin called the factor of safety. An analysis was performed to demonstrate the stability of proposed cap section during static conditions. An acceptable factor of safety is 1.5 or greater to guard against slope failure. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

An analysis was also performed to demonstrate the stability of proposed cap section during seismic conditions. An acceptable factor of safety is 1.0 or greater to guard against slope failure. The analysis was performed in accordance with the requirements of 40 C.F.R. § 257.63 and the seismic factor of safety was found to be greater than 1.0.

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after the known final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30-day period after last known receipt of waste.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, Duke Energy shall prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

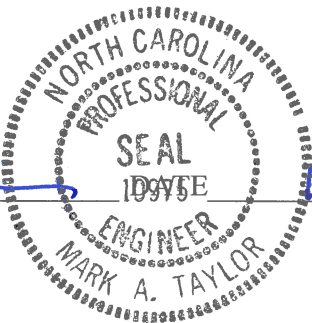
<u>Time</u>	<u>Activity</u>
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor

Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Mark Anderson Taylor, being a registered Professional Engineer in the State of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this Closure Plan dated October 10, 2016 was conducted in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE

Mark A. Taylor  10/10/16

Prepared by:



W.S. LEE STEAM STATION
PRIMARY ASH BASIN
SECONDARY ASH BASIN

CLOSURE PLAN

OCTOBER 7, 2016

Certified by:



6000 Fairview Road, Suite 200

Charlotte, North Carolina 28210

License Number: South Carolina 934

WSLEE_CLOSE_PLN

Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the W.S. Lee Steam Station (W.S. Lee) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). URS Corporation – North Carolina (AECOM) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Primary Ash Basin and Secondary Ash Basin (Ash Basins) located in Anderson County, South Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR units requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in South Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps required to close the Ash Basins at W.S. Lee consistent with recognized and generally accepted good engineering practices. Closure of the Ash Basins will be designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The Ash Basin will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R § 257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basins include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to a permitted on-site landfill. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankments will be breached pursuant to a South Carolina Department of Health and Environmental Control (SCDHEC) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure.

Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time, and the estimates are based on bathymetric surveys, historical topography, and soil borings as of January 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Primary Ash Basin	1,112,000
Secondary Ash Basin	24,000
Estimated Total	1,136,000

4 ESTIMATE OF LARGEST AREA REQUIRING COVER SYSTEM

CCR will be removed from the Ash Basins pursuant to 40 C.F.R. § 257.102(c); therefore no final cover system will be required in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the Ash Basins will be initiated pursuant to 40 C.F.R. § 257.102(e) and is expected to be completed within seven years of the commencement of closure activities. The closure time frame includes a two-year time extension beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basins will need to be lengthened due to:

- The Primary Ash Basin being larger than 40 acres (estimated 48 acres);
- The volume of bulk water/free liquids to dewater (estimated 74.7 million gallons in the Secondary Ash Basin); and
- The compliance activities required for permitting the on-site landfill.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basins within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from the SCDHEC and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basins are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basins will be completed by 2024.

Table 2. Estimated Time Frame for Closure Activities

Closure Activity	Time Frame (years)*
SCDHEC Closure Plan Approval	1
SCDHEC Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	3
CCR Grading and Excavation	3
SCDHEC Dam Decommissioning Approval	0.5
SCDHEC Landfill Approval	1.5

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, John D. Priebe, being a licensed Professional Engineer in the state of South Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 7, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE

DATE

10/7/16

